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| EXAMINER |
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SONG, MATTHEW J

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| ART UNIT | PAPER NUMBER |
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1722

DATE MAILED: 09/21/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/904,131

Applicant(s)

UEDA, TETSUZO

Examiner

Matthew J. Song

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 July 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 11,24-26 and 28-32 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 11,24-26 and 28-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 31-32 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter, which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 31 recites, "flattening the epitaxial layer having a III-V nitrides alloy and the layered substrate after the epitaxial layer is grown on the layered substrate" in lines 4-5. There is no support for flattening after deposition of the epitaxial layer. The entire specification is directed to the deposition of the epitaxial layer causes flattening. There is no support for a post-deposition flattening step.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

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4. Claim 11 is rejected under 35 U.S.C. 102(b) as being anticipated by Pankove (US 3,922,703).

Pankove discloses a layer of silicon is epitaxially grown on a sapphire substrate by using silicon-on-sapphire technology, this reads on applicant's layered substrate comprises sapphire on silicon, and then a layer of insulating gallium nitride, this reads on applicant's Group III nitride, is epitaxially grown on the substrate (col 2, ln 40-68 and Fig 1).

5. Claim 11 is rejected under 35 U.S.C. 102(b) as being anticipated by Mikoshiba et al (US 4,511,816).

Mikoshiba et al discloses forming an AlN single crystal epitaxial film on a silicon on sapphire substrate (col 9, ln 25-40, claims 1 and 22). AlN reads on applicant's Group III nitride because Aluminum is a Group III metal and the silicon on sapphire substrate reads on applicant's layered substrate.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out

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the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

7. Claim 11 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishimura (US 5,081,519) in view of Tischler et al (US 5,679,152).

Nishimura discloses a single crystal III-V compound semiconductor layer epitaxially grown on a silicon on sapphire substrate (Abstract, col 1, ln 1-10 and col 2, ln 20-55).

Nishimura discloses growing III-V compound semiconductor, however Nishimura does not explicitly disclose Group III nitrides.

In a method of making a GaN article, Tischler et al teaches providing a substrate which is epitaxially compatible with GaN, depositing a layer of single crystalline GaN and removing the substrate from the GaN layer (Abstract). Tischler et al also teaches silicon and sapphire may be used as sacrificial substrates (col 7, ln 10-30).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nishimura by growing GaN, as taught by Tischler et al, because GaN is a desirable substrate body for the fabrication of microelectronic structures (col 2, ln 1-25).

Referring to claim 24, the combination of Nishimura and Tischler et al teaches removing the substrate ('152 Abstract).

8. Claim 11 and 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishimura (US 5,081,519) in view of Molnar (US 6,086,673).

Nishimura discloses a single crystal III-V compound semiconductor layer epitaxially grown on a silicon on sapphire substrate (Abstract, col 1, ln 1-10 and col 2, ln 20-55).

Nishimura discloses growing III-V compound semiconductor, however Nishimura does not explicitly disclose Group III nitrides.

In a method of producing quality Group III-V substrate, Molnar teaches a GaN layer formed on a substrate of sapphire, silicon or a layered structure composed of combinations of these materials (col 7, ln 1-20 and Abstract). Molnar also teaches removing the substrate by etching or by electrochemical polishing, this reads on applicant's mechanical polishing, or by any other suitable process (col 11, ln 25-40). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nishimura et al by forming GaN, which a Group III-V compound, as taught by Molnar because GaN is useful in the production of LEDs (col 1, ln 20-50) and the selection of known materials based on its suitability for its intended purpose is held to be obvious (MPEP 2144.07).

9. Claims 28-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishimura (US 5,081,519) in view of Tischler et al (US 5,679,152) as applied to claims 11 and 24 above, and further in view of Olsen et al ("Calculated stresses in multilayered heteroepitaxial structures").

The combination of Nishimura et al and Tischler et al teaches all of the limitations of claim 28, as discussed previously, except the claimed thickness of the silicon layer and the epitaxial layer and the claimed wafer bowing.

In a method of calculating stresses in a multilayered structures, Olsen et al teaches a method of determining the radius of bowing based on the properties of the layers forming the

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multilayered structure using a combination of equations (pg 2543-2544). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Nishimura et al and Tischler et al by using the equations taught by Olsen et al to optimizing the thickness of the silicon and epitaxial layers minimize the bowing to obtain the values claimed by applicant.

10. Claims 28-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mikoshiba et al (US 4,511,816).

Mikoshiba et al discloses forming an AlN single crystal epitaxial film on a silicon on sapphire substrate (col 9, ln 25-40, claims 1 and 22). AlN reads on applicant's Group III nitride because Aluminum is a Group III metal and the silicon on sapphire substrate reads on applicant's layered substrate. Mikoshiba et al also discloses the temperature coefficient of the a silicon on sapphire substrate is positive (col 6, ln 60-65), the temperature coefficient of the AlN film is negative and the resulting characteristic varies in accordance with the thickness of the AlN film and the thickness may be determined so that the temperature variation rate approaches zero (col 4, ln 40-67), which is a teaching that thickness is a result effective variable. Wafer bowing

Mikoshiba et al does not teach the claimed thickness and the claimed wafer bowing for claims 28-30. However, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Mikoshiba et al by optimizing the thickness of the silicon and the epitaxial layer by conducting routine experimentation of a result effective variable. Wafer bowing is a result of differences in thermal coefficients during a temperature change and the method taught by Mikoshiba et al is to a product a device which is stable to variation in

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temperature; therefore the bowing is inherently within the claimed range because Mikoshiba et al teaches the temperature variation rate approaches zero (col 4, ln 50-65).

11. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nishimura (US 5,081,519) in view of Molnar (US 6,086,673) or Nishimura (US 5,081,519) in view of Tischler et al (US 5,679,152) or Mikoshiba et al (US 4,511,816) or Pankove (US 3,922,703) as applied to claim 11 above, and further in view of Morishita et al (WO 00/19500 A1), where US 6,768,175 is used an accurate translation.

The combination of Nishimura and Molnar or the combination of Nishimura and Tischler or Mikoshiba et al or Pankove teaches all of the limitations of claim 26, as discussed previously, except the process of forming the layered substrate includes a heating step, wherein the layered substrate exhibits bowing after being cooled down from the heating step.

In a method of forming a silicon-on-sapphire substrate, Morishita et al teaches a silicon layer was grown on a sapphire substrate at 950°C and was subsequently heat treated at 550°C for 30 minutes ('175 col 15-67), this reads on applicant's heat step and cooling down.

The combination of Nishimura and Molnar or the combination of Nishimura and Tischler or Mikoshiba et al or Pankove is not limited to any particular method of forming the silicon on sapphire substrate. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Nishimura and Molnar or the combination of Nishimura and Tischler or Mikoshiba et al or Pankove with Morishita et al's method of forming a silicon on sapphire substrate because the substrate taught by Morishita et al has improved crystallinity and surface roughness ('175 col 19, ln 1 to col 20, ln 30).

The combination of Nishimura, Molnar and Morishita et al or the combination of Nishimura, Tischler and Morishita et al or the combination of Mikoshiba et al and Morishita et al or the combination of Pankove and Morishita et al is silent to the substrate exhibits bowing after cooling. However, the substrate inherently exhibits bowing after cooling because of the large difference in thermal expansion coefficients for sapphire and silicon, as evidenced by Olsen et al.

Response to Arguments

12. Applicant's arguments with respect to claims 31-32 have been considered but are moot in view of the new ground(s) of rejection.

13. Applicant's arguments filed 7/5/2005 have been fully considered but they are not persuasive.

Applicant's clarification of the record, in regards to the rejection of claims 28-30 over Mikoshiba is noted but is not persuasive. Applicants allege that Mikoshiba is not used to reject claim 11, which claims 28-30 depend; therefore the rejection should be withdrawn. However, the Examiner did rejection claim 11 over Mikoshiba, note item 4 on pages 2-3 of the office action. Therefore, the argument is not persuasive and the rejection of claims 28-30 is maintained.

Applicant's argument that Pankove and Mikoshiba teach a silicon-on-sapphire substrate and not a sapphire on silicon substrate is noted but is not found persuasive. Applicant's allege Pankove and Mikoshiba teach a GaN/Si/sapphire and an AlN/Si/Sapphire substrate and claim 1 claims an epitaxial layer/sapphire/Si structure. The Examiner agrees that Pankove and Mikoshiba teach an epitaxial layer/sapphire/Si, but the Examiner does not agree that the claim structure is an epitaxial layer/Sapphire/Si. The claim is merely directed to forming an epitaxial layer on a

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sapphire-on-silicon substrate and the claim does not specifically require forming the epitaxial layer on the sapphire side of the substrate. The claim is not limited to forming the epitaxial layer on the sapphire and is open to the formation of the epitaxial layer on the silicon surface of a layered sapphire and silicon substrate.

The same arguments applied to Pankove and Mikoshiba apply to the Nishimura rejection.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Iida et al (JP 53-028374) teaches growing a silicon layer only on the back surface of a sapphire wafer to reduce warpage (English Abstract).

15. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

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however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Duane Smith can be reached on 571-272-1166. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

MJS
September 7, 2005

Matthew J Song
Examiner
Art Unit 1722



ROBERT KUNEMUND
PRIMARY EXAMINER